STATE COMMENT LETTER -- For Electronic Distribution

State of Nevada
Department of Conservation and Natural Resources
Division of Environmental Protection
Bureau of Federal Facilities
333. W. Nye Land, Room 138
Carson City, Nevada 89706-0851

September 21, 1999

Ms. Runore C. Wycoff, Director
Environmental Restoration Division
U.S. Department of Energy
Nevada Operations Office
P.O. Box 98518
Las Vegas, Nevada 89193-8518

RE: Review of Corrective Action Investigation Plan, Revision 1
Corrective Action Unit 98, Frenchman Flat
Federal Facility Agreement and Consent Order

Dear Ms. Wycoff:

The Final Corrective Action Investigation Plan (Revision 1) for Corrective Action Unit (CAU) 98, Frenchman Flat, has been reviewed by the staff of the Nevada Division of Environmental Protection's (NDEP's) Bureau of Federal Facilities (BFF). The Frenchman Flat Corrective Action Investigation Plan (FF-CAIP), Revision 1, is hereby approved with comments, which are given below pursuant to Subpart XII.8.a of the Federal Facility Agreement and Consent Order (FFACO).

The NDEP comments regarding the FF-CAIP (Rev. 1) (document) are arranged as follows. The General Comments are given in the body of this letter. The page-specific comments are then given as an Attachment. An evaluation of the degree to which the comments provided by NDEP regarding the Preliminary Frenchman Flat CAIP (PFF-CAIP-R1) has been used as guidance toward producing an acceptable document was conducted as well. It was found that Specific Comments 7, 11, 14, 17, 19, 20, 38, 40, and 41 regarding the PFF-CAIP-R1 provided by NDEP were not used in the construction of the FF-CAIP. Thus, some comments of the same types have been required regarding this document as well.

Please be aware that the Department of Energy must address NDEP's comments in the subsequent document. Failure to address the comments will cause NDEP to construe the subsequent document(s) as Substantially Deficient pursuant to Subpart VIII.3.b of the FFACO. As a general note, proposed extensions of future deadlines must be applied for in accordance with Subpart X of the FFACO.

NDEP recognizes that as characterization /field work proceeds, changes in the scope of the investigation may be required or justified based on information developed in the course of the ongoing work. Changes to the scope of work that was approved in the CAIP should be proposed to NDEP as soon as possible.

It should be noted that if the proposed alternative in the subsequent Corrective Action Decision Document (CADD) for this CAU is not clean closure, then, following a review and preliminary determination of the appropriateness of the proposed action by NDEP, it will be necessary to present the proposed alternative to the Community Advisory Board by way of satisfying the requirement for public notice of a proposed action prior to formal approval of the document and recommended action by NDEP. For CAUs not located on the Nevada Test (NTS) and when the recommended alternative is not clean closure, the CADD must state that the agency which is ultimately responsible for managing the land on which the CAU is located has accepted the proposed action including the need for Land Use Restrictions (LURs). Certification that the LURs have been entered in the appropriate tracking system must be provided in the subsequent Closure Report.

On 07/23/99, the document Corrective Action Investigation Plan (Revision 1) for Corrective Action Unit 98: Frenchman Flat, Nevada Test Site, Nevada, Revision No.: 1, July 1999 (document), was received by the Nevada Division of Environmental Protection (NDEP). Prior to receiving Revision 1 of the Frenchman Flat CAIP, NDEP had received, reviewed, and provided comments on three earlier versions, namely:

1.) Corrective Action Investigation Plan
For Corrective Action Unit 98:
Frenchman Flat, February 1997, Revision 0
Preliminary Draft.

2.) Corrective Action Investigation Plan
For Corrective Action Unit 98:
Frenchman Flat, June 1997, Revision 0
Final

3.) Corrective Action Investigation Plan
For Corrective Action Unit 98:
Frenchman Flat, February 1999, Revision 1
Preliminary Draft.

Following the review of this fourth document which presents DOE's plans to investigate Frenchman Flat, NDEP considers this an appropriate time to take a step back and review several longstanding reservations we have had with the proposed work. In the interest of moving forward on this project, NDEP has approved the CAIP in its current form so that the work may proceed forward as envisioned by DOE. Nevertheless, NDEP wishes to summarize and reiterate the fundamental concerns we continue to hold with regard to the planned work.

GENERAL COMMENTS

General Comment No. 1 - Insufficient Data

NDEP is concerned with the quantity and adequacy of the existing data as identified in the CAIP. The limited data will impact the accuracy, confidence, reliability, and acceptance of all work performed under this CAIP. Of particular concern is the lack of site-specific data for parameters vital to the development of the flow and transport models. The lack of data that NDEP is concerned with includes, but is not limited to the following:

- The number of drill holes and monitoring wells is quite limited for the size of the area.

- The measurements from the existing monitoring wells are water table measurements only and not measurements of hydraulic head. There are no monitoring wells completed to give piezometric surfaces at depth. Therefore, it is impossible to determine the actual flow directions into and out of the basin. Since Frenchman Flat is a closed basin and not a stream channel, the flat water table may be an indication that the outflow from the alluvial basin does not exceed the inflow.

- The drill holes are not at depth. Only one drill hole penetrated the full thickness of the alluvial aquifer. There is no clear indication of the actual thickness of the alluvium, the location of the bedrock, or whether the lower carbonate aquifer is in contact with the alluvium.

- There is a lack of actual hydrologic characterization. There was only one aquifer test in the basin, the Cambric Experiment. The test was not designed to give hydrogeologic data and has only limited data regarding the aquifer characteristics.

- NDEP believes that due to the limited quantity of existing data that all of the data will be used for development of the model leaving no data for model verification.

- There are no pollutant or contaminant data for events in Frenchman Flat with the exception of the Cambric Event.

- Finally, in a matter related to insufficient data, it is NDEP's contention that references to previous work and citation of data sources have been insufficiently specific.

General Comment No. 2 - Conceptual Model Not Strongly Supported

NDEP feels that the conceptual model is limited and does not fully consider or address several potential hydrogeologic scenarios that would have direct bearing on flow and transport characteristics within the model area. The conceptual model does not indicate the extent to which DOE understands flow into and out of the basin. Furthermore, it fails to show the extent of DOE's understanding of the flow through the Corrective Action sites, or of contaminant migration.

For example, pages 88 to 106 (Section 3.6), provide DOE's conceptual model of the Frenchman Flat CAU. This conceptual model is primarily based on and is " . . . *adapted from the regional model*." (Page 89). The

Frenchman Flat CAU within the regional model is a relatively small area. Therefore, the conceptual model only provides generalized descriptions of the study area. There does not appear to be any enhancement of the conceptual model using site-specific data.

The importance of the conceptual model cannot be over stressed, as it is the initial starting point for development of the CAI and the development of the Data Quality Objectives. With strong reservations, NDEP will use this conceptual model for the basis of its evaluation of the CAI noting its limitations.

General Comment No. 3 - Uncertainty Analysis Credibility

NDEP is concerned that a credible uncertainty analysis cannot be conducted due to a lack of data and a conceptual model that does not take into account other plausible hydrogeologic scenarios which could influence contaminant movement. This concern arises for the following reasons.

Data used to construct probability density functions (pdfs) for parameters used in the model are limited and thus may not reflect the true variabilities found in the field. This may in turn result in uncertainty analysis results that understate the level of parameter uncertainty.

A significant contributor to model uncertainty is the uncertainty over the hydrogeologic model which controls contaminant transport. Attempting to quantify uncertainty through the planned analysis, yet not account for the considerable uncertainty in the conceptual model, may result in misleading conclusions.

General Comment No. 4 - Provisional Model Acceptance by NDEP Prior to Validation Plan

Provisional acceptance of the FF CAU model(s) by NDEP is needed before a validation plan can be considered for review. While the statements in the document may be matters of language only, the language on p. 21 of the document, "*The CAU model will then be presented to NDEP and a peer review panel for review and comment. The comments will be incorporated, as necessary, to produce an acceptable CAU model. Based on the CAU model results, a proposal will then be presented to NDEP for validating the CAU model.*" This does not appear to convey the correct impression of the actual process. This in turn means, in the context of the flow chart given in Figure 1-2 that the process cannot progress beyond the second box from the top of the flow chart until the model is provisionally accepted by NDEP.

In particular it should be noted that incorporating comments from the various reviewers/groups is insufficient, in and of itself, to produce an acceptable model. Furthermore, if the CAU model is rejected by NDEP, then, it will be the responsibility of NDEP to evaluate DOE proposals for data collection, etc. to remedy the situation. NDEP notes that the CAIP defines the process without prescribing the number of interim steps eventually leading to an acceptable result. At all stages, NDEP reserves its rights to be informed of the work in progress, review it as needed, and comment accordingly.

General Comment No. 5 - Standards for Review

An important aspect of the work proposed is the development of a valid hydrogeologic model. The process of model validation involves following a modeling protocol. That is, a series of steps which, when followed, builds support in demonstrating that a given site-specific model is capable of producing meaningful results. These steps include:

1) Establishing the model purpose
2) Developing a sound conceptual model
3) Selecting a computer code that is appropriate for the system being modeled, followed by verification that the code fulfills all predefined requirements
4) Designing the model in a manner which follows accepted modeling practice
5) Calibrating the model with an acceptable degree of variance to site-specific conditions
6) Performing sensitivity and uncertainty analyses to quantify and assess model performance
7) Verifying the representativeness and uniqueness of the model against an independent set of site-specific data
8) Running predictive simulations that are in accordance with the objectives of the modeling exercise
9) Presenting clear and complete documentation of the modeling results
10) Performing a postaudit as part of a proof-of-concept undertaking

NDEP will verify that these steps have been followed in the ensuing FF-related documents that DOE will submit. As stated in General Comment No. 4, NDEP expects to be informed of progress made on these interim steps and be given the opportunity to review and comment on support documentation generated as part of each step.

General Comment 6 - Basis of Approval

NDEP is approving the CAIP only after reviewing the true usefulness of a modeling approach for investigating flow and transport phenomena. Numerical models have only limited value when they are used simply as a management tool or to answer an important question. Rather, they are most useful when used as tools to help us understand a hydrogeologic system. This powerful utility is used most effectively to test conceptual models, to aid in the design of the investigation, and to help direct data collection of those parameters the model indicates are of particular importance in the system being modeled. Model refinement and the investigator's understanding of the system progress forward hand in hand. Model results are most valuable when model development is made an integral part of an iterative approach to investigating the aquifer system. NDEP encourages DOE to consider this reasoning as it builds the Frenchman Flat flow and transport model and proceeds with the Corrective Action Investigation.

NDEP, while having major concerns as expressed in General Comments 1 through 6, believes that conducting the modeling activities outlined in the FF-CAIP-R1 will help determine the true understanding of the Geology and Hydrologic System. If the modeling fails to achieve the primary goals, then the process outlined in the FFACO Strategy for the UGTA Subproject will guide the CAI back through the data collection and modeling process.

Technical questions regarding this matter may be addressed to either C. Goewert at (702) 486-2865, C. Case at (775) 687-4670 Ex. 3029, or S. Jaunarajs at (775) 687-4670 Ex. 3030. Questions of a programmatic nature may be addressed to either K. Beckley at (775) 687-4670 Ex. 3033 or P. Liebendorfer at (775) 687-4670 Ex. 3039.

Sincerely,

Paul J. Liebendorfer, P.E.
Chief
Bureau of Federal Facilities

PJL/KKB/REN/SJ/CJG/CC/js
Enclosure

cc: w/enclosure
Ken Hoar, DOE/EPD
Dave Bedsun, DTRA
Patti Hall, DOE/ERD
Frank Di Sanza, DOE/MWD
Robert Bangerter, DOE/ERD
Jeff Johnson, NDEP/CC
Mike McKinnon, NDEP/LV
Earle Dixon, CAB Technical Advisor
Bob Loux, NWPO

SPECIFIC COMMENTS

The following are NDEP's Specific Comments regarding the Final "Corrective Action Investigation Plan for Corrective Action Unit 98: Frenchman Flat, Nevada Test Site, Nevada" (document).

Specific Comment No. 1

On p. 1 of the document it is stated that " . . . *the purpose of the CAI is . . . to gather data sufficient to characterize the nature, extent, and rate of migration or potential rate of migration from releases or discharges of pollutants or contaminants and/or potential releases or discharges form corrective action units identified as the facilities . . . " (FFACO, 1996).* The requirement to " . . . *gather data sufficient to . . . "* stands and this component of the Corrective Action Investigation (CAI) will be judged at the time the document Underground Test Area Project, Corrective Action Unit 98: Frenchman Flat, Volume III - Groundwater Flow and Contaminant Transport Model Documentation Package is reviewed. (Cf. General Comment (GC) No. 1)

Specific Comment No. 2

On p. 2 of the document Figure 1-1 is titled "*Location of the Frenchman Flat Corrective Action Unit"* The Figure shows clearly the surface boundary of the Frenchman Flat Corrective Action Unit (FF CAU). There is no requirement for the ultimate acceptable "*contaminant boundary*" mentioned in the third bullet item on p. 3 of the document to coincide with the FF CAU boundary.
(Cf. GC No. 4)

Specific Comment 3

On p. 3 of the document, it is stated that one of the "*Specific objectives of the Frenchman Flat CAI is . . .* " to "*Determine the characteristics of the groundwater flow system, the sources of contamination, and the transport processes to acceptable levels of uncertainty."*
Whether or not a "*credible numerical model of groundwater flow and contaminant transport for the Frenchman Flat CAU and down gradient areas*" has actually been developed, will be evaluated by NDEP in the context of GC 5.

Specific Comment No. 4

On the bottom of page 3 and top of page 5, it is stated that the modeling area is intentionally large to include all possible pathways for radionuclide migration. DOE must identify the specific data used to determine these pathways. (Cf. GC No. 2)

Specific Comment No. 5
On page 5, **Section 1.3.1.2 Development of CAU Model** it is discussed that the refined regional model will be

used to develop the refined conceptual model. It would appear that the reverse should actually be the case, namely that improvements in the FF CAU-specific model(s) should lead to improvements in the adjacent portions of the regional model. It is assumed that a geologic model will be developed prior to the development of the groundwater flow model, and the geologic model will be used to further refine and develop a flow and transport model. Again, sufficient CAU-specific field data is the basis for a credible geologic model. (Cf. GC No. 2)

Specific Comment No. 6

On page 7, its states "*When the CAU model is completed, it will be reviewed by a peer review panel, DOE and NDEP."* NDEP will require DOE to provide information on the peer review teams' comments, and a plan on addressing any necessary changes in the model or the study. Any proposed scope of work for gathering additional information will be treated as an addendum to the FF CAIP and as such will require NDEP review and concurrence prior to the proposed work commencing. (Cf. GC No. 4)

Specific Comment No. 7

On p. 12 of the document Subpart II.1.b.ii is quoted and is "*Determine whether releases of pollutants and/or hazardous wastes or potential releases of pollutants and/or hazardous wastes are migrating or potentially could migrate, and if so, identify the constituents, their concentration(s), and the nature and extent of that migration."* Subsequently, in this connection, it is stated that "*In accordance with Subpart II.1.b.ii, a near-field and a CAU-scale groundwater flow and contaminant transport models will be developed to evaluate whether releases and migration of contaminants are occurring based on the existing data."*

The results of contaminant transport modeling must be checked against actual pollutant/contaminant data in and on the boundary of the CAU. The use of modeling based on limited data does not necessarily " . . . *evaluate whether releases and migration of contaminants are occurring* . . . " and is insufficient to satisfy the requirements of Subpart II.1.b.ii of the FFACO.
Comparison of model output with groundwater pollutant/contaminant field data is required. This comparison will need to occur during the CAI. (Cf. GC 5)

Specific Comment No. 8

On p. 12 of the document Subpart II.1.c of the FFACO is quoted as part of the statement of purpose of the FFACO and reads "*Providing all parties with sufficient information to enable adequate evaluation of appropriate remedies by specifying the radioactive and hazardous constituents for each CAU."* The subsequent, related statements that " . . . *a preliminary list of radioactive and hazardous constituents for the Frenchman Flat corrective action unit is provided in Section 3.5 of this document."* and "*This list provides all parties with sufficient information to enable adequate evaluation of appropriated remedies and will be updated based on the findings made during the CAI."* are entirely insufficient to satisfy the requirements of Subpart II.1.c. "*Sufficient information"* includes at the minimum the species of indicator pollutants and contaminants including the species and concentrations, with time, of successive indicator daughter products, their respective locations in the

subsurface, and their respective rates of migration.

Developing sufficient information to satisfy the requirements of Subpart II.1.c of the FFACO must be conducted during the CAI.

When the above process is repeated using classified data, a revaluation by NDEP will necessarily occur. (Cf. GC No. 1)

Specific Comment No. 9

On p. 13 of the document it is stated that "*The DOE and NDEP will work together throughout the implementation of the strategy for each of the UGTA CAUs, including the Frenchman Flat CAU."*

This statement, perhaps unintentionally, does not pinpoint the actual nature of the relationship between the NDEP as an Environmental Regulatory Agency, and the DOE as a member of the environmentally regulated community. While NDEP may interact with members of the environmentally regulated community and may offer informal technical comments and regulatory information, NDEP retains its authority to advise the regulated community of and enforce legal and regulatory environmental requirements. (Cf. GC No. 4)

Specific Comment No. 10

On p. 14 of the document it is stated"*CAU models utilizing tritium as the source term will be used to establish the contaminant boundary for each CAU."* Nowhere in, the document is there an identifiable discussion of the actual measurement of values of transport parameters for tritium in groundwater. The basis for the assumed probability density functions (pdfs) for transport parameters for t tritium for use in modeling, particularly for the FF-CAU, has not been demonstrated. A FF-specific data basis for these transport parameter pdfs would add significantly to the credibility of model(s) using them. (Cf. GC Numbers 1, 4, 5)

Specific Comment No. 11

On p. 20, it is stated"*The regional groundwater flow model is used to define boundary conditions and initial estimates of recharge for the CAU-scale groundwater model."* DOE has repeatedly affirmed that the regional groundwater model is neither capable nor intended to predict conditions at any particular location within the area it covers. Since, by their very nature, boundary conditions are specified at a series of specific locations, NDEP has concerns regarding the feasibility of using the regional groundwater flow model to define boundary conditions for the CAU-scale model.

This same comment applies to Figure 3-8 titled "*Simulated Regional Hydraulic Heads Contours in Frenchman Flat Area and Vicinity"* on p. 53 of the document. NDEP expects that the results and the assumptions leading to them will be discussed in the model documentation packages. (Cf. GC Numbers 1, 2, 4)

Specific Comment No. 12

On p. 20, it is stated that "*Hydraulic conductivity data obtained from aquifer tests conducted in the CAU or the surrounding region are used to define an initial distribution."* NDEP finds the term "initial distribution" to be vague, and has to speculate as to its meaning. This term needs to be defined. (Cf. GC Numbers 1, 4)

Specific Comment No. 13

On p. 21, it is stated that "*Based on the CAU model results, a proposal will then be presented to NDEP for validating the CAU model."* Basing the decision as to whether or not to present NDEP at some particular time a plan for "*validating the CAU model*" on "*model results* would be interpreted by NDEP to mean that the basis for determining that the time had arrived to make this decision would be overall model credibility and current and prospective utility. (Cf. GC Numbers 4, 5)

Specific Comment No. 14

On p. 41 Eq. (3-1) is given as follows.

$$K_{depth} = K_h (10^{-\lambda d})$$

where:

K_{depth} = horizontal hydraulic conductivity at specified depth (meter/day)

K_h = horizontal hydraulic conductivity at land surface (meter/day)

λ = Hydraulic conductivity decay constant (1/meter)

d = depth from land surface (meters)

Several points are relevant here.

First, Eq. (3-1) does not account for hydrogeologic strata making angles greater than zero ° with the horizontal and so is not reflective of actual reality in the field.

Second, for d = 0, which corresponds to land surface, $K_{depth} = K_{h,}$ thus *de facto* setting K_{depth} equal to zero which is the value of saturated hydraulic conductivity at land surface absent a recent rainfall-runoff event. What really appears to be meant by the equation is that the quantity given as hydraulic conductivity at land surface, K_h, is really the maximum value of saturated hydraulic conductivity at the location of interest. Some additional explanation or reworking of the equation appears indicated.

Third, discussion of the sampling, etc. resulting in measured values the depth dependence of λ is not given. Further, the reference given on p. 43 which would presumably contain this information, namely " . . . *regional model document (DOE/NV, 1997) . . . "* is insufficiently specific.

The three specific deficiencies just identified must be corrected in the work leading to the CADD and in the CADD as well.

As a final point, the ratio of vertical to horizontal hydraulic conductivity is not discussed. This ratio is important for predictions of vertical flow, and is expected to vary from one geologic stratum to the next. This deficiency needs to be remedied in subsequent documents as well. (Cf. GC Numbers 1, 4, 5)

Specific Comment No. 15

Section 3.4.8.1 Porosity is presented on pages 70, and 72 to 76. In this section, there is no indication that porosity values have been estimated within the Study areas. All of the porosity values are estimated or they are statistical estimates. NDEP is concerned with this lack of specific porosity values. Further, it is uncertain how the model will be validated without these supporting data for the FF CAU. (Cf. GC Numbers 1, 2, 4, 5)

Specific Comment No. 16

On pp. 79 and 80, Table 3-17 gives values for "*Tritium and Technetium Diffusion Coefficients for the Welded Tuff Aquifer, Yucca Mountain".* No correlation between these values and diffusion coefficients specific to the geologic units of the FF CAU is given. Hence, the values of these diffusion coefficients, which depend on ambient groundwater chemistry as well as rock type, which in turn determines the connected porosity, pore/capillary size distribution, and contributes to the overall groundwater chemistry, are of unknown value in the FF-modeling work. (Cf. GC Nos. 1, 2)

Specific Comment No. 17

On p. 80 it is stated that "*Table 3-18 lists $_{KD}$ (distribution coefficient) values as reported by studies of the NTS and Yucca Mountain project for selected contaminants that may be of concern to the Frenchman Flat CAU."* No correlation between these values and those specific the FF CAU is given.

Since values of distribution coefficient depend on ambient groundwater chemistry as well as rock type, via connected porosity, pore/capillary size distribution, and contributions to ambient chemistry, the use of values of distribution coefficient not specific to the localities of the FF-CAU is of unknown validity.

Actual values of K_d for the FF CAU are required for use in the model(s) for the needed model credibility to be achieved. (Cf. GC Nos. 1, 2, 4, 5)

Specific Comment No. 18

On p. 104 the statement is made that "*Considering the 1,000-year time frame of interest, the regional model simulations conducted for the VOIA (IT, 1997c) predicted that contamination from DILUTED WATERS will remain within the Alluvial Aquifer."* Modeling the movement of "*contamination from DILUTED WATERS*" has not been shown to be credible from the perspective of radionuclide availability. In addition, no statement has been made in the document regarding modeling cell size. A cell that is overlarge to show appropriate CAU-scale detail, likely with the regional model, will cause the concentrations of contaminants to be artificially diluted and therefore contribute artificially to retardation and hence lower contaminant concentrations as a function of time.

Further, as has been noted repeatedly previously, at the UGTA Information Exchange Meeting held in Las Vegas, Nevada on July 18, 1996, Geotrans, Inc., the subcontractor to IT responsible for the regional model stated that it was **not** the purpose of the regional model to "*accurately predict shot-scale flow phenomena"* as the calculation just cited purports to do. (Repeated querying of DOE on this aspect of the purpose of the regional model has continued to result in statements to the effect that the Geotrans, Inc. statement quoted above is still taken to be correct.)

Thus, the modeling "results" discussed on pp. 103-104 are entirely unsupported, and if repeated in the FF model(s) shortly to be reviewed, will likely contribute to rejection of the model(s) by NDEP. (Cf. GC Nos. 1, 4, 5)

Specific Comment No. 19

On p. 120 the statement is made that "*As stated in Section 2.1.2, DOE/NV will keep NDEP informed of the progress of all CAI activities."* In accordance with the results of the discussion between DOE and NDEP at the meeting on 05/26/99 in the Carson City offices of NDEP, it should be recalled that notification to NDEP of each impending "modeling step" is required. Thus, NDEP will interpret " . . . *all CAI activities* . . . " to include the modeling steps shown in the left-hand column of Table 5-1 on p. 121 of the document. (Cf. GC Nos. 4, 5). Additionally, NDEP interprets the term “informed” to mean briefed in a conference call or meeting and issued the applicable supporting documentation as appropriate for that modeling step.

Specific Comment No. 20

On p. 128 the statements are made that "*The hydraulic conductivity of the geologic units is a major control on the movement of groundwater. Hydraulic conductivity values have been measured in numerous wells in and around the NTS."* One of the geologic characteristics of the NTS is its "complicated" geology, which means that the geology, and hence geologic controls on flow vary greatly from one location to the next. Thus, the associated hydraulic conductivity values that have been " . . . *measured in numerous wells in and around the NTS* . . . " have not been shown in the document to be applicable to the FF CAU.

NDEP will consider this matter of CAU-specific applicability of data used in the model in its review of the draft modeling documents. (Cf. GC Nos. 1, 2, 4, 5)

Specific Comment No. 21

On p. 12 the statements are made that "*Good storage coefficient data requires that an aquifer test be performed with two wells, one a pumped well and the other an observation well. Few such tests were conducted on the NTS due to the cost of installing the observation well. Several aquifer tests in carbonate rocks away from the NTS also provided good storage coefficient values. (Bunch and Harrill, 1984)."* Three points are relevant here.

First, no mention is made of FF CAU-specific storage coefficient data or of any plans to relate FF CAU-specific storage coefficient data to other measured values.

Second, the geologic complexity of the NTS precludes assuming that storage coefficient measurements on the NTS are representative of the FF CAU without explicit evidence to this effect.

Third, the statement that "*Several aquifer tests in carbonate rocks away from the NTS also provided good storage coefficient values."* is unhelpful in that

a) No correlation between the results of tests in "*...carbonate rocks away from the NTS...*" with actual conditions at the FF CAU is made.

b) The alluvium in the FF CAU is unaddressed by this statement.

c) The phrase "*...also provided good storage coefficient values..."* makes the two entirely unwarranted assumptions that the "*...few such tests conducted on the NTS..."* were somehow "*...good...*" and that the measurements in "*...carbonate rocks away from the NTS...*" were also somehow "*...good...*". "Good" means at the minimum

i) demonstrated applicability to the FF CAU

ii) appropriate measurement methodology

Regarding this latter point (ii above), appropriate measurement methodology means using mathematical formula(e) to analyze the two-hole data that are suited to actual aquifer conditions. No such demonstration of appropriate analysis has been given with regard to either of the sets of measurements mentioned in the document.

Thus, on both counts (i and ii) "good" has yet to be demonstrated-the unsupported assertion by itself is not sufficient.

CAU-specific data are required to be developed during the Corrective Action Investigation to produce a credible model. (Cf. GC Nos. 1, 2, 3, 4, 5)

Specific Comment No. 22

On pp. 129-131, the statements are made that "*Later, a classified dataset, based on information from individual tests will be used to calculate the final location of the contaminant boundary. ... Scientists at LLNL will model the release of radionuclides from the CAMBRIC test to provide the flux of radionuclides from the cavity, the puddle glass, and the rubble chimney (source term model). ... This combination of data will also form the basis for the classified source term that will be assigned to each of the underground test locations in Frenchman Flat."*

Three points are relevant here.

First, it has not been actually demonstrated that any of the CASs in the FF CAU other than the CAMBRIC event actually contribute to the radionuclide inventory in the groundwater at the FF location. In fact, statements made earlier in the document suggest otherwise. The lack of such an explicit demonstration militates against the credibility of "*...a classified dataset, based on information from individual tests...*" when there may actually not be any. This point needs to be clarified.

Second, the plan to "*...model the release of radionuclides from the CAMBRIC test to provide the flux of radionuclides..."* actually means attempting to construct a numerical model to match the observed release of radionuclides from CAMBRIC. This is not the same as providing a hydrologic source term suitable for fate and transport modeling.

Third, the statement that " *This combination of data will also form the basis for the classified source term that will be assigned to each of the underground test locations in Frenchman Flat."* lacks credibility due to the first and second points just given. (Cf. GC Nos. 1, 2, 4, 5)

Specific Comment No. 23

On p. 132, the statements are made that "*For the transport simulations, an expected value for each radionuclide will be chosen from the published ranges. ... Typically, the expected value will be chosen to be conservative (i.e., closer to the low side of the range of values)."* In statistical usage, the term "*expected value"* means "*average over a pdf (probability density function)".* In the present instance, this would mean that the "*...published ranges...*" of values should have been used to determine one or more pdf(s) which are then used to produce the continuous analog of a weighted average. This process does not include values "**chosen"** at one location or another of the pdf, for example at the "*...low side of the range of values... ".*
Thus, the process for determining values of distribution coefficients just described is invalid. An appropriate process, as just described, should be followed. (Cf. GC Nos. 1, 2, 4, 5)

Specific Comment No. 24

On p. 136 the statements are made that "*The contaminant transport simulations will all be performed under transient conditions. Some of the codes do not include a steady flow option, but rather reach steady-state by leaving parameters fixed and performing transient simulations over long periods of time until steady-state is reached. This approach is adequate, but somewhat slower than if a true steady-state option were available."*
The difficulty here may be one of language only, but some confusion between transient, steady-state, and

equilibrium, not mentioned in the discussion, appears to be present.

First, it appears that "*transient*" is taken to mean that flow conditions and some causes of changes in flow conditions, such as variable pumping, vary with time.

Second, and this is not consistent with the use above of "*transient*", it appears that if all pumping is at constant rates, and no other changes in the system, such as rainfall and infiltration, which are certainly time-dependent events in the real world, are considered, then the system can be thought of as being in a steady state, which means constant flows at given locations, though possibly different flows at different locations.

It may be that a large number of "*transient simulations*" is required for the flows throughout the modeling area to "catch up" with initially imposed constant pumping or other constant initial change to the system and that this is meant by the statement that "*This approach is adequate, but somewhat slower than if a true steady-state option were available."*

Third, given the above, it appears from the statement "*This approach is adequate, but somewhat slower than if a true steady-state option were available."* that some confusion exists between what constitutes "*steady state*", described above, and what constitutes equilibrium, not mentioned in the discussion, which actually means no flows at all. Lack of clarification of this point is a deficiency that needs to be remedied. (Cf. GC Nos. 3, 4, 5)

Specific Comment No. 25

On p. 136 the statements are made that "*A key aspect of the CAU model will be an assessment of the amount of uncertainty in the predictions. One approach suitable for assessing uncertainty is the Monte Carlo method. In a Monte Carlo simulation, parameters are varied within specified limits defined by probability distributions. This code-selection attribute requires that the selected code has the ability to accept data sets generated either internal or external to the program."*

Two points are relevant here.

First, some connection with actual FF CAU-specific hydrologic data and assumed "*probability distributions*" of hydrologic parameters is required. Absent this connection, the Monte Carlo method as described above is not a suitable approach for "*...assessing data uncertainty"* (Data uncertainty cannot be assessed with insufficient data.).

Second, as has been discussed above, "*data*" should not be confused with model input. Model input can be "*...generated... internal to the program.*" but "*data*" cannot.

The deficiencies in the discussion just identified need to be remedied. (Cf. GC Nos. 1, 2, 3, 4, 5)

Specific Comment No. 26

On p. 138 the statement is made that "*Colloid transport is expected to be a more important issue for fractured units such as the Lower Carbonate Aquifer than for porous units like the Alluvial Aquifer."* The reason for this supposition is not given in the discussion. The basis for this supposition should be explicitly given. (Cf. GC No. 1, 2)

Specific Comment No. 27

On p. 152 the statement is made that "*The scale of the CAU models will be the approximate size of the CAU and the region downgradient in which the contaminant boundary is likely to occur."* As has been pointed out previously, attempting to define a "*contaminant boundary*" that keeps pace with constantly migrating groundwater contamination is acceptable as an initial model exercise. Making predictions regarding the movement of the contaminant boundary and testing these against the results of actual drilling and groundwater sampling in the field would be appropriate. (Cf. GC Nos. 4, 5)

Specific Comment No. 28

On p. 152 of the document the statements are made that "*The SWIFT code is a finite-difference code; therefore, the approach for defining grids will be the same as the approach described in the regional flow model document (DOE/NV, 1997). The CAU model layers will be flat lying with layer boundaries chosen to coincide with key HSU boundaries in key locations."* In any credible fate and transport modeling exercise the model is fitted to the geology, etc., and not the reverse. It appears from the statements just quoted that the "*...CAU model layers will be flat lying..."* for convenience for fitting the layers to the numerical code, rather that fitting the numerical code to the actual layering in the field.

It may be that a finite element code should be chosen rather than a finite difference code for ease of fitting the code to the layers rather than attempting to fit the layers to an apparently inappropriate numerical code. (Cf. GC Nos. 4, 5)

Specific Comment No. 29

On p. 163 the statements are made that "*The internal and external peer groups will be asked to attempt to identify fatal flaws in the CAU model and to evaluate whether the modeling process has been applied correctly. In addition, the peer reviewers will be asked to assess the ranges of parameter uncertainty incorporated into the CAU model and to verify that the range of parameter uncertainty is inclusive."*

First, it should be explicitly noted that one of the possible "*...fatal flaws in the CAU model...*" could well be a lack of data. This possibility is certainly something that NDEP will consider in its evaluation of the FF CAU model(s).

Second, assessing the "*...ranges of parameter uncertainty...to verify that the range of parameter uncertainty is inclusive."* amounts to likely having larger ranges of the hydrogeologic variables in the model(s) than would be

warranted by actual field data.

This amounts to larger ranges of "realizations" and greater uncertainty in model "predictions" which are not of value when a "reasonably realistic picture of contaminant migration is required by NDEP. This aspect of the modeling work will be scrutinized by NDEP in making its decision as to whether or not to provisionally accept the model(s). (Cf. GC Nos. 1, 2, 3, 4, 5)

Specific Comment No. 30

On p. 163 the statements are made that "*Model verification is defined as the testing of predictions of the calibrated model against available data not used in the model production and calibration. ... Transient hydraulic head response data from water supply well pumping will be used to verify the groundwater flow model calibration prior to the sensitivity and uncertainty analyses and the model review. This verification consists of a transient flow calibration which includes adjusting the storage coefficient to match simulated to observed drawdown in wells."*

Adjusting the storage coefficient is most emphatically **not** the same as "*...the testing of predictions of the calibrated model against available data not used in the production and calibration."* Attempts to substitute "*adjusting...the storage coefficient*" for "*testing of predictions*" will likely result in NDEP rejecting the model(s). (Cf. MV, GC Nos. 3, 4, 5)

Specific Comment No. 31

On p 164 the statements are made that "*One of several approaches may be used to determine if the new data verify the CAU model predictions. In the case of data for which the number of values are sufficient to determine a pdf, the new data will be shown to be consistent with the previously defined pdf by comparing mean and standard deviation values before and after inclusion of the new data. If the new data do not significantly change the mean and standard deviation, that parameter will be considered verified. In other cases, for which upper and lower bounds have been defined, the new data will be compared with the bounds. the new data will be considered to be verified if the results fall within the 5 percent and 95 percent ranges defined for that data."*

A number of points are relevant here.

First, the only way in which "*...new data*" can "*...verify the CAU model predictions*" is that predictions are made using the model and these predictions are then compared with measurements of the parameter(s), using indicator pollutants and contaminants in the groundwater at a specific time and specific location in the field.

Second, "showing" that "*new data*" are "*consistent with the previously defined pdf by comparing mean and standard deviation values before and after inclusion of the new data*" is statistically indefensible as follows.

a) "*Previously defined pdf*" actually means "assumed pdf" so that there is actually **no** pdf data set for inclusion of new data nor a data basis for "assuming" a particular pdf in the first place.

b) Thus, attempting to show that the "new data" (the term "new data" is misleading as noted above since the pdf is "assumed" and not actually determined from data collected at the FF CAU) are "*...consistent with the previously defined pdf by comparing mean and standard deviation values before and after inclusion of the new data."* is a process that is not explicitly defined, does not provide a unique pdf for the "new data", and does not provide a comparison of model output with field reality.

c) The related statement that "*If the new data do not significantly change the mean and standard deviation, that parameter will be considered verified*." is statistically indefensible.

The statements quoted above attempt to confuse the statistically indefensible statement that "*If the new data do not significantly change the mean and standard deviation, that parameter will be considered verified."* with actual verification of model predictions.

Third, the only acknowledgment that the assumed ranges of the of the input parameter values (In general, denoting values of input parameters generated from pdfs by the term "data" is entirely misleading.) and assumed pdfs can affect model output as in the statement on p. 164 that "*If the data significantly modify the pdf or if they fall outside of the 5 percent and 95 percent ranges, the CAU model will not have been verified."* Once again, "*Model verification is defined as the testing of predictions of the calibrated model against available data not used in the model production and calibration.*", not in comparing the ranges of data collected to those of an "assumed" pdf.

The parameter values corresponding to the "*5 percent and 95 percent ranges"* is a model credibility issue. Parameter ranges that are not supported by explicit data from the FF CAU and environs are not credible and could likely cause NDEP to not provisionally accept the draft model. (Cf. GC Nos. 1, 2, 3, 4, 5)

Specific Comment No. 32

On p. 164 the statement is made that "*The results will be presented as a median location of the contaminant boundary along with 5 percent and 95 percent locations of the contaminant boundary based upon the uncertainty analyses."* In standard statistical terminology, the median of a distribution, presumably generated in the present instance as a pdf of "predicted" contaminant boundary locations, is the value of the independent variable, the value of the pdf being the dependent variable, that divides the area under the pdf into two equal areas.

It is not clear from the document why the median would be used to determine the location of the "predicted" contaminant boundary instead of the mode of the distribution which is its maximum, and hence most probable value. This point requires discussion in the appropriate FF modeling document(s). (Cf. GC Nos. 4, 5)

Specific Comment No. 33

On pp. 164-165 the statement is made that "*In all cases, the contaminant boundary location will be calculated from the contaminant concentration data generated by the contaminant transport model."* "Model output" rather than "data" would be appropriate terminology here. "Data" refers to field or laboratory "data", not output from

a numerical model. Also, the use of "estimated" rather than "calculated" in the sentence quoted above would more accurately convey the actual situation. (Cf. GC Nos. 1, 2, 4, 5)

Specific Comment No. 34

On p. 166 the statement is made that "*For the CAU model results to be considered valid, the groundwater flow through the CAU model must be in balance with the regional model predictions."* This statement is not necessarily correct.

First, it is the general expectation that the more detailed FF CAU modeling will result in refinement of the regional model at the boundaries and through the interior of the FF CAU.

Second, since, as noted above, the regional model is not intended to make flow predictions at any specific locations in the area it covers, comparing CAU-scale predictions against regional model predictions may be problematic at best. (Cf. GC Nos. 1, 2, 4, 5)

Specific Comment No. 35

On p. 167 the statement is made that "*By examining the flow field through each of these realizations, it is possible to derive estimated values of effective parameters, such a dispersivity, at scales appropriate for the CAU model."* This process can only proceed via a comparison of the model output with appropriate data which have not been demonstrated to exist for the FF CAU. (Cf. MV, GC Nos. 1, 2, 4, 5)

Specific Comment No. 36

On p. 168 the statements are made that "*The integrated flux of radionuclides, in moles per time, leaving the cavity and melt glass region and passing through a plane approximately two cavity radii away is determined for each radionuclide. That mass flux of radionuclide is the amount of mass included as a source term in the CAU transport model."* It is not clear how DOE intends to assess the complexity of the daughter products in the fate and transport calculations. NDEP is concerned that successive indicator daughter products due to the original radionuclide source term have not been included in the total radionuclide portion of the source term inventory. (Cf. GC Nos. 1, 2, 4, 5)

Specific Comment No. 37

On p. 169 the statement is made that "*The existing data were deemed sufficient to develop a CAU-scale groundwater flow and contaminant transport model, use it to evaluate the impacts of various sources of uncertainty, and subsequently decide whether additional data were needed or not."*

In the event that the model is not accepted by NDEP, plans for any additional work will need to be presented to NDEP as an addendum to this CAIP. (Cf. GC Nos. 1, 2, 3, 4, 5)

Specific Comment No. 38

On p. 169 the statement is made that "*The CAU model will be used to assess the impacts of various sources of uncertainty using sensitivity and uncertainty analyses."* This assessment of "*impacts of various sources of uncertainty..."* can only be accomplished using a model that has output bounded in known ways by actual data values. A model which is entirely uncertain due an overall lack of data cannot be used credibly in this way. It has not been demonstrated in the document that such needed FF CAU-specific data are actually available. (Cf. GC Nos. 1, 2, 3, 4, 5)

Specific Comment No. 39

On p. 170, the statement is made that "*If either DOE or NDEP find the level of uncertainty unacceptable, additional characterization activities will be considered."* This statement is not accurate. If NDEP considers the "*level of uncertainty unacceptable"*, additional characterization activities will likely be required by NDEP. (Cf. GC Nos. 1, 3, 4, 5)

Specific Comment No. 40

On p. 170 the statement is made that "*If additional data collection is necessary, the types and/or locations of new data would be determined using the results of the CAU-scale model, particularly the sensitivity and uncertainty analysis results."* As noted above, a valid model is required for results of the "*...sensitivity and uncertainty analysis results*." to have value. If it were to transpire that the draft model were to be rejected by NDEP on the basis on initial data insufficiency the "*...sensitivity and uncertainty analysis results.*" would likely be of extremely limited and unknown value. (Cf. MV, GC Nos. 1, 2, 3, 4, 5)

Specific Comment No. 41

On p. 170 the statement is made that "*Plans for any additional data collection, data analysis activities, and CAU model update would be documented in a separate plan as an addendum to the CAIP."* This statement is entirely correct. Such a plan would be required in the event NDEP does not provisionally approve the model. (Cf. GC Nos. 1, 2, 4, 5)